Interconnectivity, open access & digitalization – new potentials for food & nutrition science

National University Professional Updates

Singapore September 26, 2017, Mikkelsen BE

Rapid digitalization, fast globalization and the complexity of societal challenges in the field of food and nutrition calls for new interdisciplinary modes of research cooperation. Challenges such as NCDs, food security for all and climate crisis can no longer be viewed in silos and isolation within traditional scientific paradigms. Rather, they are expected to be addressed across sectorial and scientific disciplinary borders. At the same time, digitalization creates new opportunities and detailed digital patterns of daily human food shopping transactions as well as new kinds of consumer wearable leave new kinds of digital traces. This offers possibilities for epidemiologists and interventionists including the part of the sector responsible for risk assessment advice for public authorities. In addition, this has created a call for a new "openness" where data and lab facilities increasingly are becoming a part of the sharing economy. Food data on food composition, population food behavior and intake in the area move towards open access, data sharing, data democracy and data philanthropy. Food scientists cannot longer work in mono disciplinary modes, but must increasingly share data and lab resources across institutional and national borders. And since much of the digital insight are created in food retail, in apps and in SoMe scientists must increasingly engage in data multi stakeholder sharing undertakings and participate in new collaboratory research infrastructures. This presentation uses the EU Richfields design study as its empirical source and takes a close look at the idea of interconnectivity strategies in food and nutrition science following in the wake of the surge created by digitalization, globalization and cross-disciplinarity. The presentation will take some of the ongoing other "big food data" programs such as DISH-RI, Smart Food, ENDAPISE; DEDIPAC and MetroFood as a point of departure and present the first drafts for the future European Food Nutrition Health Research Infrastructure. These programs are all expected to be influential in the coming years. The presentation will disclose some of the insights from the Richfields study in terms of some of the new potentials coming from both new types of soft new datasets as well as from hard lab based structures where smart sensors are used to study behavioral nutrition. This is for instance the casein Restaurant of the Future (NL), the ETH fake food buffet (CH) and the AAU FoodscapeLab (DK). Some of the devices from the last will be presented and finally, the presentation will discuss some of the implications for food, nutrition and health sciences in the future.

Traditional dietary surveys
Sending the 7d food record on retirement?

1

- 7 day food record
- High drop out rate
- Primarily ressource full respondents
- Labor intensive data cleaning
- Often 3-4 years before reporting

- Costumer generated
- Card based (loyalty, credit etc)
- Directly interface to TradeSync
- Realtime
- Online
- Based on DonateYourData

example

Tracing blue green algae adverse effects in Pacifi oyster in coastal areas

2

example

Testing consumer acceptance of a new food authencity label

3

example

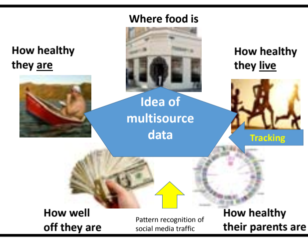
Common to all

1. Can´t be done using a single source
2. Relying on "the digital" Volume, Velocity & Variety
3. Can only be done by resssource sharing
4. Linking different datasets
5. Dependent on "remote sensing"
6. Works Realtime
7. Works in the "web-of-food" borderline"

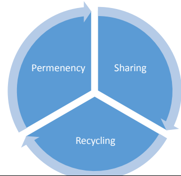
1. Requires validation
2. Common protocols
3. Calibration
4. Payrolls, Staff
5. Coordination & bizz model
6. Is permanent
7. Is multistakeholder
8. = the basic idea of a research infrastrcuture

Five challenges – one answer
Research infrastructures?

1. Complexity of RQ's require inter university cooperation
2. Research are no longer neccessarily the best to create data
3. Open science calls for sharing of data
4. Project created data tends to vanish post-project
5. Society increasingly expects realtime answers



Data for food, nutrition and health science
- a new digital driven sharing economy?



Digitalisation & nutrition
facts & figures DK/Nordics

- Between 82% and 92% of the population use mobile ICT devices daily.
- 89 % of Danish consumers own a mobile phone/smart phone
- 88 % of Danes carry out digital self-service
- 88% of Danes do e-Shopping
- 22 % of internet users between 16 and 74 are skeptical about IT security
- Penetration of wearables and according to Statista - the sale of smart watches has risen by 141 percent in recent years*
- 52 % of information workers across 17 countries report using + 3 three devices for work**

Statistics Denmark, http://www.dst.dk/da/Statistik/Publikationer/VisPub?cid=019373
* Statista, Nordics
** https://blogs.business.microsoft.com/en-us/2016/02/16/employee-devices-bring-added-security-concerns/

Big Data Informs Food Research Infrastructures

2 dimensions. Hard & Soft

Hard part: labs, devices, machines etc

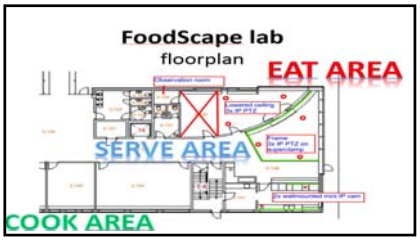
Soft part: multi source data

Richfields case study on "hard infrastructures"

Zürich, Wageningen & Aalborg

FoodScape lab

floorplan



First 5 devices

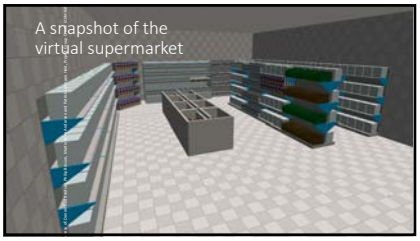
- Intelligent Buffet that can record food intake in canteen environments
- Virtual Food Choice Simulation which can create food environments
- The FoodScape Heatmapping is used for analysis of motion and food choices
- FoodScape Tracking for executing real time food ethnography
- Dietary Intake Monitoring System (DIMS) that can be used for capturing food intake and food waste.

The Intelligent Buffet. FoodScapeLab in coop with Syscore

The Intelligent Buffet

Virtual Food reality

Virtual Food reality



A snapshot of the virtual supermarket

Realtime dietary assessment technologies and ICT - assisted foodchoice data acquisition.

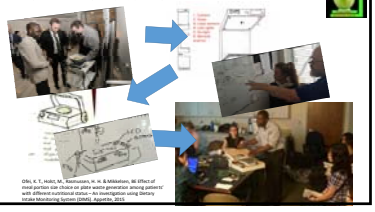
New imaging technologies for food identification

Other approaches

- ASA24 – Automated Self Administered 24hdr
- TADA: Technical Assisted Dietary Assessmen
- Diet Data *Recorder* System (DDRS)
- Smart Plate
- Smart Fork
- TelSpec

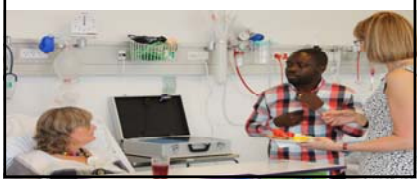
http://www.tadaproject.org/

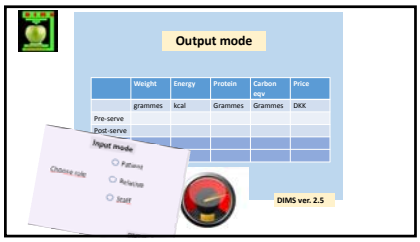
From DIMS1.0 to 1.5



DIMS ver 2.0
on the go design

Feasibility & stress test at Herlev





Is the DIMS accurate?
Validation Study 1: Herlev Hospital

Intervention:
- Front End Nutrition & Meal support
- Meal hosting

Results:
- No significance pre- og post test
- DIMS functions well with a trained operator
- Meal hosting requires training

Acknowledgement: catering manager Michael Allerup Nielsen

Ofei, K.T¹, Andersen, T² and Mikkelsen, B.E³. Measuring effect of Changes in Meal Service at hospital using digital technology – case insights from the Dietary Intake Monitoring System study

Is the DIMS accurate?
Validation 2: Odense University Hospital

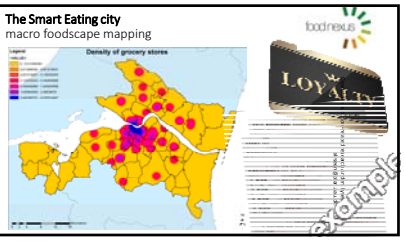
- **Hypothesis**
- High correlation between DIMS data and standard weighed method

- **Results:**
- Correlation: DIMS total energy/standard total energy (r= 0.990 and p value = 0.01)
- Correlation: DIMS total protein/standard total protein (r= 0.974 and p-value=0.01)

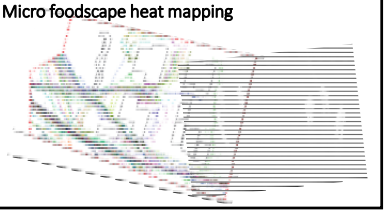
Acknowledgements: Dr. Rudolf Albert Scheller, Geriatric Dept G, Odense

Ofei. KO, ul Ain, Q, Scheller, R & Mikkelsen, BE: Validation of a novel image-weighed technique for monitoring food intake and estimation of portion size in hospital settings. Submission Public Health Nutrition. Sept *2017*

The Smart Eating city
macro foodscape mapping



Micro foodscape heat mapping



From FSL to Street Science & Food'n Science

- Foodscape Lab. Teaching of graduate students
- Refined at annual Researchers Festivals
- Refined at Annual culture nigths
- Conceptualized in the Food'n Science Program

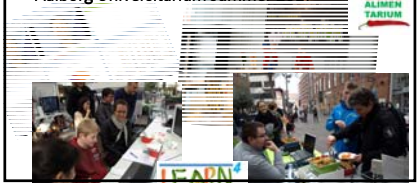
Three iterations on smart devices

- Augmented reality technology for plant food literacy training – the VeggiMatchi food educational app. Ada Zawadzka
- Sensorial shopping in the virtual vegetable market Shova Acharya
- The Eye4Food plant food literacy trainer for kids in kindergarten. Shova Acharya

Conceptual & policy foundation

- **Learning concepts**
  - **Concept of knowledge triangle**. The dynamic teraction between research, education and innovation
  - **Problem Based Learning**. To learn trough projects adressing problems
  - **Experiential learning.** learning through reflection on doings
- **Danish school reform provisions**
  - **Supportive learning**: using everyday life problems as learning
  - **Open school:** reaching out & bringing outsiders in a "teachers"
  - **Natural science based data collection** in upper secondary school: digitalising experimentation
  - **STEM:** General increased focus on importance of STEM

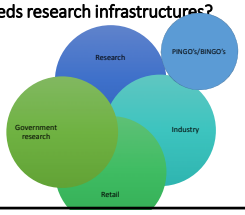
Refining Food'n Science components at Aalborg Universitarium summer 2017



Learning insights from FSL

- Lab approach provide opportunities for research regarding ideas & concepts for consumer food choice and behaviour studies for both research and education.
- Studies in the lab are designed **as experiments**, with a **hypothesis** and with dependent and independent variables.
- Often developed **in small scale pilots studies** based on prior developed ideas.
- For technologies to prove their performance, **validation studies** are necessary.
- Important aspect of lab experimentation relates to the **biases** introduced.
- Potential bias is the "noise" introduced by **inviting subjects into lab environment**
- Labs **are expensive** - More stakeholders need to collaborate.

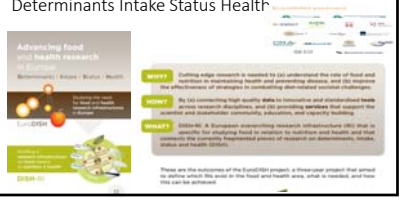
Who needs research infrastructures?



Examples of Early European Research Infrastructures in the field of nutrition

DISH RI 1

Determinants Intake Status Health



Metrofood 2

better food metrics

3

FOODHAY: a proposal for a Danish RI
Open innovation FOOD and Health lAboratorY

The Danish Roadmap for Research Infrastructures

Endapadasi JPI 4

European Nutritional Phenotype Assessment and Data Sharing Initiative

- Determinants
- Indicators of eating
- Policy option evaluation

- Aim: to deliver an **open access research infrastructure** that will contain data from a wide variety of nutritional studies, ranging from **mechanistic/interventions** to **epidemiological studies** including a multitude of phenotypic outcomes that will facilitate combined analyses in the future.

Dedipac 5

Determinants of Diet and Physical Activity Knowledge Hub

1) Towards harmonisation of measurement methods and surveillance

2) Towards better insight in the contextual and individual determinants and their interplay

3) Towards better evaluation and benchmarking of policies and interventions

Ended 2016

What the RI is & what it's not?

• Not

- A single big source data source
- A turn key business
- A profit undertaking
- A static phenomena
- A single country activity
- A competitor to traditional market intelligence

Hot

A multiple big source data platform
A European activity
A patchwork of different sources
A business
A data democracy
A dynamic phenomena
An infrastructure for research
…. and hopefully something more

What is the Business model for Universities?

- European and country contact point in the science domain (foodsystem/food/nutrition/health/sustainability)
- Joint acquisition and executing of research projects within the science case as RI related topics
- Scientific publications and papers to build a publication rack record in the RI domain, link PhD to RI activities
- Developing user community, including training and education
- Investment in Business Development activities and Networks, relevant to the RI and Scienc ce case
- Building the RI is a short cut to get research grants; data, tools and services are key.
- Run the RI as a business – income and ependiture

In conclusion

- Complex:
- More universities
- More stakeholders
- More countries
- Food compete with other RI
- Advocacy needed
- Clarity & vision is needed
- Data Diplomacy needed
- Small scale & Pilot projects needed

How can we assess "platforms"

- Permanancy
- Selfcontainedness
- Multistakeholder value
- Sustainability
- Visibility
- Privacy proofed
- User friendliness
- Value proposition clarity
- Stakeholder support
- Novelty value

Thanks for your attention

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